Subcategories and MACT Floor Determinations for Existing Stationary Reciprocating Internal Combustion Engines (RICE)

Presented by:

ICCR RICE Work Group

Presented to:

ICCR Coordinating Committee

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Long Beach, California

Purpose

The purpose of this presentation is threefold:

1. Provide the RICE Work Group's determinations for subcategories and MACT floors for existing RICE
2. Review the rationale that led to the development of the subcategories and MACT floors for existing RICE
3. Request that the Coordinating Committee forward the subcategories, MACT floors, and rationale to EPA

Topics

- Changes Made to MACT Floors
- RICE Subcategories
- MACT Floors for Existing RICE
- Rationale for Subcategories and MACT Floors
- Recommendation to Coordinating Committee

Changes Made to MACT Floors

- RICE Work Group presented preliminary MACT floors for existing RICE at April 1998 CC meeting
- MACT floors to be presented today incorporate guidance received from the CC
- Changes:
  - Subcategory for emergency power units added
  - Subcategory for small engines added
  - Good combustion practices reviewed
  - Emissions data, state air regulations, & air permit limitations for HAPs reviewed
  - Rationale for subcategory and MACT floor determinations documented

RICE Subcategories

RICE Work Group has determined that the following ten subcategories should be established for existing RICE for the purposes of MACT floor:

- Spark-Ignition, Natural Gas, 4-Stroke Rich Burn Engines
- Spark-Ignition, Natural Gas, 4-Stroke Lean Burn Engines
- Spark-Ignition, Natural Gas, 2-Stroke Lean Burn Engines
- Spark-Ignition, Digester Gas and Landfill Gas Engines
- Spark-Ignition, Propane, Liquid Petroleum Gas (LPG), and Process Gas Engines
- Spark-Ignition, Gasoline Engines
- Compression-Ignition, Liquid Fuel Engines (diesel, residual/crude oil, kerosene/naphtha)
- Compression-Ignition, Dual Fuel Engines
- Emergency Power Units
- Small Engines (200 brake horsepower or less)

MACT Floors for Existing RICE

RICE WG has reached consensus on the following MACT floors for existing RICE, by subcategory:

RICE Subcategory	MACT Floor
Spark-Ignition, Natural Gas 4-Stroke Rich Burn Engines	Non-Selective Catalytic Reduction
Spark-Ignition, Natural Gas 4-Stroke Lean Burn Engines	No Control
Spark-Ignition, Natural Gas 2-Stroke Lean Burn Engines	No Control
Spark-Ignition, Digester Gas and Landfill Gas Engines	No Control
Spark-Ignition, Propane, LPG, and Process Gas Engines	No Control
Spark-Ignition, Gasoline Engines	No Control
Compression-Ignition, Liquid-Fuel Engines (diesel, residual/crude oil, kerosene/naphtha)	No Control
Compression-Ignition, Dual Fuel Engines	No Control
Emergency Power Units	No Control
Small Engines (200 brake horsepower or less)	No Control

Rationale for Subcategories (1 of 5)

- Ten subcategories established to distinguish between different classes of engines
- Subcategories incorporate the following factors:
  - Fuel type
  - Engine design characteristics
  - Emergency power use
  - Small engine size

Rationale for Subcategories (2 of 5)

Fuel Type

- RICE use a variety of liquid and/or gaseous fuels
- Fuels are not interchangeable
- Fuel type affects combustion, which may influence HAPs formation and emissions
- Fuel type can affect the viability of control options to reduce HAP emissions from RICE
  - Landfill gas and digester gas tend to foul catalytic controls
  - Some oxidation catalysts may be unsuitable for liquid fuel compression ignition engines depending on sulfur content of the fuel

Rationale for Subcategories (3 of 5)

Engine Design Characteristics

ignition system (CI or SI), scavenging cycle (4-stroke, 2-stroke), and rich or lean burn

- Ignition and air scavenging cycles are not interchangeable for existing RICE
- Operation in rich or lean burn mode is principally fixed by engine design
- Engine design affects the combustion process, including factors that may influence HAPs formation
  - Fuel and air mixing, ignition, flame propagation, and quenching
- Engine design can affect the viability of control options to reduce HAP emissions from RICE
  - By affecting the exhaust constituents and exhaust temperature

Rationale for Subcategories (4 of 5)

Emergency Power Units

- Used when electric power from the local utility is interrupted or becomes unreliable
- Operate for very few hours per year
  - Outages rarely last more than a few hours, often only minutes
  - 500 hours under worst-case conditions, often as little as 50 hours
- Emissions extremely low on an annual basis
- Emissions occur only during emergency situations or to perform maintenance checks and operator training
- Add-on catalytic control devices would be less effective

Rationale for Subcategories (5 of 5)

Small Engine Size

- Engines 200 bhp or less generally have different utilization than large engines
  - More likely to be mobile sources, not stationary sources
  - Principally used for oil/gas field production or irrigation, while large engines are used for electric power generation, gas transmission, and gas processing
- Generally not located at facilities that are major sources of HAP emissions (except as emergency power units)
- Annual HAP emissions are expected to be low
- State and local air regulatory authorities generally have not required emission controls for small stationary engines

Rationale for MACT Floors (1 of 6)

- RICE Work Group determined MACT floors for existing RICE by subcategory, in accordance with 112(d) of the Clean Air Act
- Work Group reviewed the following available information related to HAPs emissions from existing RICE:
  - Existing add-on controls that may reduce HAPs
  - Existing good combustion practices that may reduce HAPs
  - Existing HAPs emissions data
  - Air regulations and air permit limitations for HAPs

Rationale for MACT Floors (2 of 6)

Existing Add-On Controls that may Reduce HAPs

- Controls that involve oxidation most likely to reduce HAPs from RICE
- Based on the ICCR Population Database, MACT floor for one subcategory should be based on add-on controls
  - Average of the best performing 12 percent of engines in the database for SI Natural Gas, 4-Stroke Rich Burn Engines is non-selective catalytic reduction (NSCR)
  - Average of the best performing 12 percent of engines in the database for all other subcategories is no add-on control
- RICE Work Group determined:
  - NSCR is MACT floor for SI Natural Gas 4-Stroke Rich Burn Engines
  - No add-on control is MACT floor control type for all other subcategories

Rationale for MACT Floors (3 of 6)

Good Combustion Practices (GCPs)

- Practices that maintain good engine performance may lead to more complete combustion and, in theory, decrease the likelihood of higher HAP emissions associated with incomplete combustion or engine failure
- Good engine performance, in general, is sustained by:
  - Proper engine operation
  - Routine engine inspection
  - Engine performance analyses
  - Engine maintenance
- Existing practices developed as a result of:
  - Economic incentives -- to improve fuel efficiency and avoid costs associated with engine failure
  - Air emission limitations for nitrogen oxides (NOx)

Rationale for MACT Floors (4 of 6)

Good Combustion Practices (GCPs) -- continued

- RICE Work Group has not identified a link between existing maintenance and operating practices and reduced HAP emissions
- Regulatory requirements for inspection and maintenance plans were identified for criteria pollutants only and only for a few sources
- Existing inspection, maintenance, and operating practices are engine-specific, site-specific, or both
- RICE Work Group concluded that no specific good combustion practices are appropriate as part of the MACT floor for existing RICE

Rationale for MACT Floors (5 of 6)

Emissions Data for HAPs

- HAP emissions data in the ICCR Emissions Database for RICE are highly variable -- reported formaldehyde levels for natural gas-fired engines cover 6 orders of magnitude
- RICE Work Group unable to identify specific factors that caused the variability
- Variability and lack of information to explain the variability precluded the Work Group from determining whether any specific emission levels reported would be achievable for existing RICE
- RICE Work Group concluded that the emissions data are insufficient to be used as the basis for MACT floor

Rationale for MACT Floors (6 of 6)

Air Regulations and Air Permit Limits for HAPs

- No air regulations for HAPs identified
- HAP permit limits reported for 49 of 28,000 engines in the ICCR Population Database
- RICE Work Group determined that HAP limits for 49 engines should not be used as MACT floor since:
  - Insufficient information in the database to subcategorize the units
  - HAP limits for the 49 engines are site-specific (all values are different) -- unclear whether the limits would be achievable for engines at other facilities
  - Unclear whether the permit limitations are based on emissions testing or on the use of emission factors, such as AP-42
  - 49 engines represent 0.2 percent of the engines in the database

MACT Floors for Existing RICE

- Based on a review of available information related to HAPs emissions from existing RICE, the RICE Work Group has determined the MACT floors, by subcategory, as presented below
  - Existing add-on controls that may reduce HAPs
  - Existing good combustion practices that may reduce HAPs
  - Existing emissions, air regulations, and air permit limitations for HAPs

RICE Subcategory	MACT Floor
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Spark-Ignition, Natural Gas 2-Stroke Lean Burn Engines	No Control
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Spark-Ignition, Propane, LPG, and Process Gas Engines	No Control
Spark-Ignition, Gasoline Engines	No Control
Compression-Ignition, Liquid-Fuel Engines (diesel, residual/crude oil, kerosene/naphtha)	No Control
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Small Engines (200 brake horsepower or less)	No Control

Recommendation to Coordinating Committee

The RICE Work Group recommends that the Coordinating Committee forward the following to EPA:

- Subcategories for Existing RICE
- MACT Floors for Existing RICE
- Rationale for Subcategories and MACT Floors